



Guidance

# **GCE Subject Level Guidance for Further Mathematics**

April 2016

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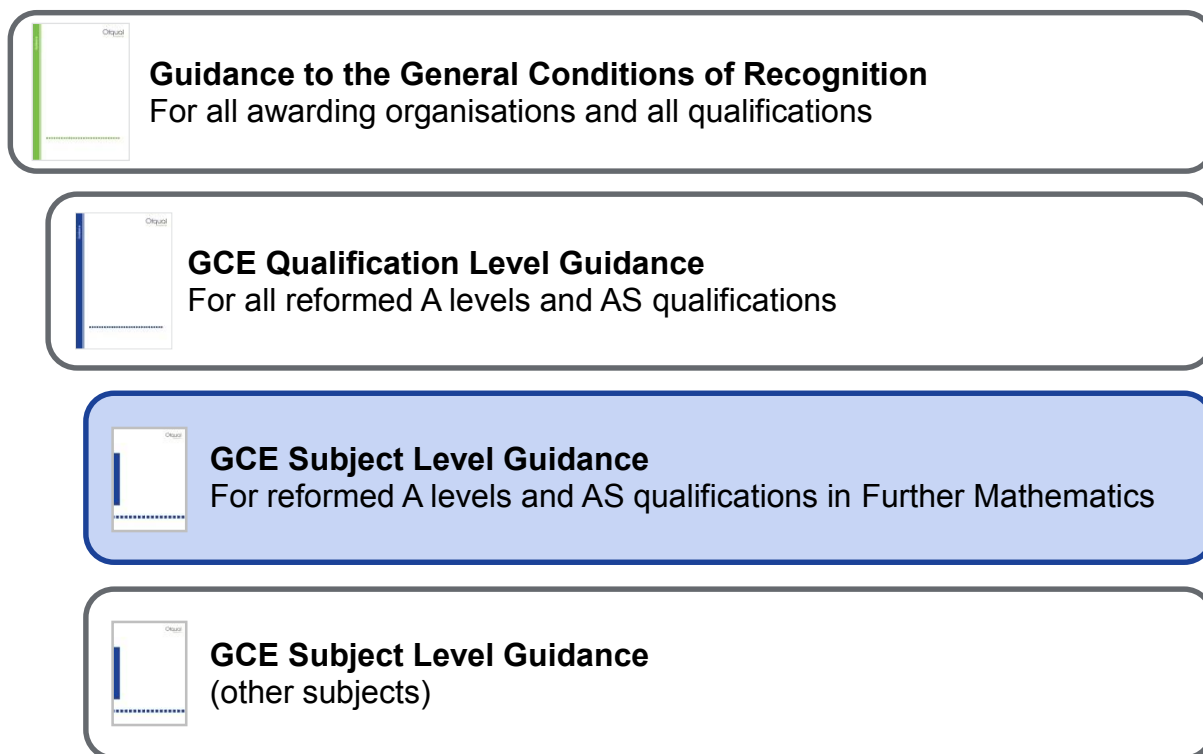
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# Introduction

## About this document

This document (highlighted in the figure below) is part of a suite of documents which outlines our guidance for awarding organisations offering GCE Qualifications.



This document sets out guidance which applies to the following qualifications:

- all GCE A levels in Further Mathematics awarded on or after 1 April 2019; and
- all standalone GCE AS qualifications in Further Mathematics awarded on or after 1 April 2018.

This guidance supports the *GCE Subject Level Conditions and Requirements for Further Mathematics*.<sup>1</sup>

This document constitutes guidance for the purposes of section 153 of the Apprenticeships, Skills, Children and Learning Act 2009 (the '2009 Act') and Condition GCE(Further Mathematics)1.2.

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<sup>1</sup> [www.gov.uk/government/publications/gce-subject-level-conditions-and-requirements-for-further-mathematics](http://www.gov.uk/government/publications/gce-subject-level-conditions-and-requirements-for-further-mathematics)

An awarding organisation has a legal obligation under the 2009 Act to have regard to this guidance in relation to each GCE Qualification in Further Mathematics that it makes available or proposes to make available. Condition GCE(Further Mathematics)1.2 imposes the same obligation in respect of the guidance below which is issued under that Condition.

An awarding organisation should use the guidance to help it understand how to comply with the requirements set out in *GCE Subject Level Conditions and Requirements for Further Mathematics*.

## **Guidance set out in this document**

<p>This document provides guidance on subject content, in relation to comparability of optional routes, and on assessment objectives for GCE Qualifications in Further Mathematics.</p>
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## Guidance in relation to subject content for GCE Qualifications in Further Mathematics

The subject content for GCE Qualifications in Further Mathematics is set out in the Department for Education's *Further Mathematics AS and A level content*, document reference DFE-00707-2014 (the 'Content Document').

Condition GCE(Further Mathematics)1.1(c) requires awarding organisations to interpret the Content Document in line with any requirements, and having regard to any guidance, published by Ofqual.

We set out our guidance for the purposes of Condition GCE(Further Mathematics)1.1(c) below.

### Overarching themes and use of technology

Paragraphs 10 and 11 of the Content Document state that –

10. A level specifications in further mathematics must require students to demonstrate the following overarching knowledge and skills. These must be applied, along with associated mathematical thinking and understanding, across the whole of the detailed content set out below. The knowledge and skills are similar to those specified for A level mathematics but they will be examined against further mathematics content and contexts.
11. The use of technology, in particular mathematical graphing tools and spreadsheets, must permeate the study of AS and A level further mathematics.

These statements should be interpreted primarily as indicating the desired approach to teaching GCE Qualifications in Further Mathematics.

However, these statements also have implications for assessments. Consequently, in respect of each GCE Qualification in Further Mathematics which it makes available, or proposes to make available, we expect an awarding organisation to explain and justify in its assessment strategy for that qualification how these statements have been reflected in the qualification's design.

## Guidance on comparability of optional routes through GCE Qualifications in Further Mathematics

The subject content for GCE Qualifications in Further Mathematics is set out in the Department for Education's *Further Mathematics AS and A level content*, document reference DFE-00707-2014 (the 'Content Document').

The Content Document allows an awarding organisation to develop a GCE Qualification in Further Mathematics which has a number of optional routes through it. Ofqual is particularly mindful of the risks to the comparability of standards that may arise if this results in a large number of optional routes.

General Condition G1.2 states that an awarding organisation must take all reasonable steps to ensure that the Level of Demand of an assessment for a qualification it makes available is consistent across all options as to tasks and alternative assessments which may be taken by the Learner for the purpose of the qualification.

Ofqual's *GCE Subject Level Conditions and Requirements for Further Mathematics* also require an awarding organisation to –

[E]xplain and justify in its assessment strategy for the qualification –

[...]

how it will secure Comparability, including over time and between any optional routes through the qualification.

Ofqual's *GCE Qualification Level Guidance*<sup>2</sup> states, in relation to Condition GCE2 (Assessment Strategies), that each awarding organisation's assessment strategy should explain how –

optional routes through the qualification... will be comparable in terms of the Level of Demand and the amount of subject content required to be taught and on which Learners will be assessed (D1.1, D1.2(c), G1.2).

We expect an awarding organisation to be able to demonstrate in its assessment strategy for a GCE Qualification in Further Mathematics that it has taken all reasonable steps to ensure that it will have maximum control over comparability of standards between different routes at all points within the cycle of setting and

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<sup>2</sup> [www.gov.uk/government/publications/gce-qualification-level-guidance](http://www.gov.uk/government/publications/gce-qualification-level-guidance)

marking assessments and awarding the qualification. In particular, this control should be such that smaller entry routes are neither advantaged nor disadvantaged.

## Guidance on assessment objectives for GCE Qualifications in Further Mathematics

Condition GCE(Further Mathematics)1.2 allows us to specify requirements and guidance relating to assessment objectives for GCE qualifications in Further Mathematics.

We published our requirements in relation to assessment objectives in *GCE Subject Level Conditions and Requirements for Further Mathematics*, and reproduce them in the table below.

	Objective	Weighting (A level)	Weighting (AS)
<b>AO1</b>	<b>Use and apply standard techniques</b> Learners should be able to: <ul style="list-style-type: none"> <li>■ select and correctly carry out routine procedures; and</li> <li>■ accurately recall facts, terminology and definitions</li> </ul>	50%	60%
<b>AO2</b>	<b>Reason, interpret and communicate mathematically</b> Learners should be able to: <ul style="list-style-type: none"> <li>■ construct rigorous mathematical arguments (including proofs);</li> <li>■ make deductions and inferences;</li> <li>■ assess the validity of mathematical arguments;</li> <li>■ explain their reasoning; and</li> <li>■ use mathematical language and notation correctly.</li> </ul> <p><i>Where questions/tasks targeting this assessment objective will also credit Learners for the ability to ‘use and apply standard techniques’ (AO1) and/or to ‘solve problems within mathematics and in other contexts’ (AO3) an appropriate proportion of the marks for the question/task must be attributed to the corresponding assessment objective(s).</i></p>	At least 15%	At least 10%



<b>AO3</b>	<p><b>Solve problems within mathematics and in other contexts</b></p> <p>Learners should be able to:</p> <ul style="list-style-type: none"> <li>■ translate problems in mathematical and non-mathematical contexts into mathematical processes;</li> <li>■ interpret solutions to problems in their original context, and, where appropriate, evaluate their accuracy and limitations;</li> <li>■ translate situations in context into mathematical models;</li> <li>■ use mathematical models; and</li> <li>■ evaluate the outcomes of modelling in context, recognise the limitations of models and, where appropriate, explain how to refine them.</li> </ul> <p><i>Where questions/tasks targeting this assessment objective will also credit Learners for the ability to ‘use and apply standard techniques’ (AO1) and/or to ‘reason, interpret and communicate mathematically’ (AO2) an appropriate proportion of the marks for the question/task must be attributed to the corresponding assessment objective(s).</i></p>	<i>At least 15%</i>	<i>At least 10%</i>
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We set out below our guidance for the purposes of Condition GCE(Further Mathematics)1.2. This guidance explains how we expect awarding organisations to interpret these assessment objectives in terms of:

- the different 'strands' within each of the assessment objectives;
- the discrete 'elements' within each assessment objective and its strands which questions and tasks could target and/or seek to credit – our expectation is that each and every question/task should target or seek to credit at least one of these elements, and may target or seek to credit multiple elements across one or more assessment objectives;
- the coverage expectations, such as in relation to the different elements within each assessment objective and how those elements should be sampled over time; and
- the key areas of emphasis in each assessment objective and the particular meaning for the subject of any key terms and phrases used; defined terms are shown in bold text, followed by their definitions.

In line with the obligations set out in Condition GCE(Further Mathematics)1.2, we expect awarding organisations to be able to demonstrate how they have had regard to this guidance. For example, an awarding organisation could map how it has regard to the guidance as it:

- develops its sample assessment materials;
- delivers the qualification;
- develops and applies its approach to sampling the elements into which the assessment objectives are divided; and
- monitors the qualification to make sure it addresses all elements appropriately.

AO1: Use and apply standard techniques			50% (A level)
Learners should be able to: <ul style="list-style-type: none"> <li>select and correctly carry out routine procedures</li> <li>accurately recall facts, terminology and definitions</li> </ul>			60% (AS)
Strands	Elements	Coverage	Interpretation and definitions
1 – select and correctly carry out routine procedures	1a – select routine procedures	<ul style="list-style-type: none"> <li>Full coverage in each set of assessments (but not every assessment).</li> <li>No more than 10% of the marks for this assessment objective should be allocated solely to strand 2.</li> </ul>	<ul style="list-style-type: none"> <li><b>Routine procedures</b> includes multi-step as well as single-step processes. They should be familiar to the Learner (including, but not limited to, those stated in the specification) and there should be no significant background context given in the question/task that would have an impact on the Level of Demand.</li> <li><b>Select</b> involves the recognition of a single- or multi-step process necessary to carry out a routine procedure (for example, solving a quadratic equation or integrating a function) in cases where the question/task does not make the required process clear. It should not be confused with the more complex decision-making required in AO3.</li> <li>Element 1a should normally be assessed in combination with element 1b.</li> <li>Within strand 2, individual questions/tasks may target each of facts, terminology and definitions in isolation, or in any combination.</li> </ul>
	1b – correctly carry out routine procedures		
2 – accurately recall facts, terminology and definitions	This strand is a single element		

AO2: Reason, interpret and communicate mathematically			At least 15% (A level)
Learners should be able to: <ul style="list-style-type: none"> <li>construct rigorous mathematical arguments (including proofs)</li> <li>make deductions and inferences</li> <li>assess the validity of mathematical arguments</li> <li>explain their reasoning</li> <li>use mathematical language and notation correctly</li> </ul>			At least 10% (AS)
Strands	Elements	Coverage	Interpretation and definitions
1 – construct rigorous mathematical arguments (including proofs)	This strand is a single element	<ul style="list-style-type: none"> <li>Full coverage in each set of assessments (but not every assessment).</li> <li>Taken together, strands 1 and 2 should comprise at least 50% of the marks for this assessment objective.</li> <li>No more than 10% of the marks for this assessment objective should be allocated to strand 3.</li> <li>No more than 10% of the marks for this assessment objective should be allocated solely to strand 5.</li> </ul>	<ul style="list-style-type: none"> <li>A <b>mathematical argument</b> leads from premises to a conclusion, through rigorous and clear reasoning. It: <ul style="list-style-type: none"> <li>may include one or both of calculations or algebraic manipulation, but is more than these alone,</li> <li>typically involves several steps, which are logical in nature and sequence, given the context,</li> <li>clearly identifies the principal results used where appropriate, and</li> <li>contains sufficient detail to allow the line of reasoning to be followed.</li> </ul> </li> <li><b>Deduction</b> means a process of reasoning from known results to conclusions that must be correct.</li> <li><b>Inference</b> means a process of reasoning from relative or partial evidence to results that are likely to be correct.</li> <li>Strand 3 could apply to <b>arguments</b> provided to a Learner, or to arguments generated by them. It may include identifying:</li> </ul>
2 – make deductions and inferences	2a – make deductions		
	2b – make inferences		
3 – assess the validity of mathematical arguments	This strand is a single element		
4 – explain their reasoning	This strand is a single element		

<b>AO2: Reason, interpret and communicate mathematically</b>			<i>At least 15% (A level)</i>
<b>Learners should be able to:</b> <ul style="list-style-type: none"> <li>construct rigorous mathematical arguments (including proofs)</li> <li>make deductions and inferences</li> <li>assess the validity of mathematical arguments</li> <li>explain their reasoning</li> <li>use mathematical language and notation correctly</li> </ul>			<i>At least 10% (AS)</i>
Strands	Elements	Coverage	Interpretation and definitions
<b>5 – use mathematical language and notation correctly</b>	This strand is a single element		<ul style="list-style-type: none"> <li>errors and/or omissions; and</li> <li>the values for, and/or conditions under, which an argument remains correct.</li> </ul> <ul style="list-style-type: none"> <li>In the context of strand 4, <b>explain</b> may include providing justification for a particular approach. Justification and/or explanation of key steps in the working should be required even where problems are otherwise fairly routine in nature.</li> <li>Strands 4 and 5 should normally be assessed in combination with strands 1, 2 and/or 3. Learners should be given multiple opportunities to demonstrate (and gain credit for) the skills required by these strands.</li> </ul>

<b>AO3: Solve problems within mathematics and in other contexts</b>				At least 15% (A level)
<b>Learners should be able to:</b> <ul style="list-style-type: none"> <li>translate problems in mathematical and non-mathematical contexts into mathematical processes</li> <li>interpret solutions to problems in their original context, and, where appropriate, evaluate their accuracy and limitations</li> <li>translate situations in context into mathematical models</li> <li>use mathematical models</li> <li>evaluate the outcomes of modelling in context, recognise the limitations of models and, where appropriate, explain how to refine them</li> </ul>				At least 10% (AS)
Strands	Elements	Coverage	Interpretation and definitions	
<b>1 – translate problems in mathematical and non-mathematical contexts into mathematical processes</b>	1a – translate problems in mathematical contexts into mathematical processes	<ul style="list-style-type: none"> <li>Full coverage of all elements except 2b and 5c in each set of assessments (but not every assessment).</li> <li>Elements 2b and 5c should be covered over the shortest period of time that is</li> </ul>	<ul style="list-style-type: none"> <li><b>Translate problems</b> may involve the Learner selecting and/or constructing appropriate mathematical processes. It may include identifying important features or variables.</li> <li><b>Translate situations in context</b> may involve the Learner selecting and/or constructing appropriate mathematical models. It may also entail constructing a model of a specific situation, following the principles of an established modelling process. It may include identifying important features or variables.</li> <li>Within strands 2 and 5, <b>where appropriate</b> means where it is meaningful to do so in the context of the question/task.</li> </ul>	
	1b – translate problems in non-mathematical contexts into mathematical processes			

<b>AO3: Solve problems within mathematics and in other contexts</b>				At least 15% (A level)
<b>Learners should be able to:</b> <ul style="list-style-type: none"> <li>translate problems in mathematical and non-mathematical contexts into mathematical processes</li> <li>interpret solutions to problems in their original context, and, where appropriate, evaluate their accuracy and limitations</li> <li>translate situations in context into mathematical models</li> <li>use mathematical models</li> <li>evaluate the outcomes of modelling in context, recognise the limitations of models and, where appropriate, explain how to refine them</li> </ul>				At least 10% (AS)
Strands	Elements	Coverage	Interpretation and definitions	
<b>2 – interpret solutions to problems in their original context, and, where appropriate evaluate their accuracy and limitations</b>	2a – interpret solutions to problems in their original context	reasonably practicable (but not necessarily in every set of assessments).	<ul style="list-style-type: none"> <li>Within strand 2, evaluating the accuracy and limitations of a solution may (but need not) extend to the problem-solving process used in generating it.</li> <li>Within strand 3, the context may be either mathematical or non-mathematical.</li> <li>A problem-solving question/task would typically exhibit<sup>3</sup> one or more of the following attributes –               <ul style="list-style-type: none"> <li>Little or no scaffolding – the Learner receives little guidance beyond a start point and a finish point, and the mathematical processes required for the solution are not explicitly stated</li> </ul> </li> </ul>	
	2b – where appropriate, evaluate [the] accuracy and limitations [of solutions to problems]	<ul style="list-style-type: none"> <li>Taken together, strands 1 and 2 should comprise at least 20% of the marks for this</li> </ul>		

<sup>3</sup> The list of attributes is not intended to be exhaustive; nor do we expect an individual question/task to exhibit all of the attributes.

<b>AO3: Solve problems within mathematics and in other contexts</b>  <b>Learners should be able to:</b> <ul style="list-style-type: none"> <li>translate problems in mathematical and non-mathematical contexts into mathematical processes</li> <li>interpret solutions to problems in their original context, and, where appropriate, evaluate their accuracy and limitations</li> <li>translate situations in context into mathematical models</li> <li>use mathematical models</li> <li>evaluate the outcomes of modelling in context, recognise the limitations of models and, where appropriate, explain how to refine them</li> </ul>			<i>At least 15% (A level)</i>  <i>At least 10% (AS)</i>
Strands	Elements	Coverage	Interpretation and definitions
<b>3 – translate situations in context into mathematical models</b>	This strand is a single element	assessment objective. <ul style="list-style-type: none"> <li>Taken together, strands 3, 4 and 5 should comprise at least 20% of the marks for this assessment objective.</li> <li>Awarding organisations</li> </ul>	<ul style="list-style-type: none"> <li>Provision for multiple representations (such as the use of a sketch or diagram as well as calculations)</li> <li>Information is not given in mathematical form or mathematical language, or results and/or methods need to be interpreted and/or evaluated (for example, in a real-world context)</li> <li>A choice of techniques to be used</li> <li>The solution requires understanding of the processes involved, rather than just application of techniques</li> <li>Two or more mathematical processes are required, or the solution requires drawing together different parts of mathematics</li> </ul>
<b>4 – use mathematical models</b>	This strand is a single element		
<b>5 – evaluate the outcomes of modelling in context,</b>	5a – evaluate the outcomes of modelling in context		



<b>AO3: Solve problems within mathematics and in other contexts</b>				<i>At least 15% (A level)</i>
<b>Learners should be able to:</b> <ul style="list-style-type: none"> <li>translate problems in mathematical and non-mathematical contexts into mathematical processes</li> <li>interpret solutions to problems in their original context, and, where appropriate, evaluate their accuracy and limitations</li> <li>translate situations in context into mathematical models</li> <li>use mathematical models</li> <li>evaluate the outcomes of modelling in context, recognise the limitations of models and, where appropriate, explain how to refine them</li> </ul>				<i>At least 10% (AS)</i>
Strands	Elements	Coverage	Interpretation and definitions	
<b>recognise the limitations of models and, where appropriate, explain how to refine them</b>	5b – recognise the limitations of models	should explain in their assessment strategies why the weightings assigned to strands 1 and 2, and to strands 3, 4, and 5 are appropriate, including for any optional routes through the qualification	<ul style="list-style-type: none"> <li>Each set of assessments should include questions/tasks where Learners are assessed on their ability to solve complete problems presented in an unstructured manner and which require the use of multiple parts of the problem-solving cycle (as defined in overarching theme 2 on pages 5-6 of the Content Document).</li> <li>Within each set of assessments, there should be opportunities for both –               <ul style="list-style-type: none"> <li>extended questions/tasks that address strands 1 and 2 in combination, and</li> <li>extended questions/tasks that address strands 3, 4 and 5 in combination.</li> </ul> </li> </ul>	
	5c – where appropriate, explain how to refine [models]			

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